This graduate course is a comprehensive introduction to the language and techniques of solid-state and materials chemistry. Emphasis will be on synthetic approaches to inorganic materials and the utility/limitations of a variety of physical characterization methods. The interplay between structure and properties of "real world" examples is described with heavy weight placed on extended bonding in solids.

**Instructor:** Prof. Edward Gillan  
**Contact info:** email (edward-gillan@uiowa.edu), phone (335-1308)

**Office hours (Zoom):** Tuesday/Thursday (11 AM -12 PM) and by appt.  
Zoom Info (HawkID authentication): Meeting ID# 985-3425-7393 ([https://uiowa.zoom.us/j/98534257393](https://uiowa.zoom.us/j/98534257393))

**Course ICON web page:** news updates, handout/PDF copies, problem set solutions, exams, web links

**Texts:** *Solid State Chemistry* 2nd ed. by A. R. West (required, ISBN: 9781119942948). ICON has link to e-book version of text. Other handout supplements from; *Solid State Chemistry Techniques (vol. 1) and Compounds (vol. 2)* by A. K. Cheetham and P. Day; assorted research articles and reviews.

**Course grading** (450 total points, +/- course grades will be given):
- 5 Problem sets @ 20 points each = 100 pts (22 %)
- 2 50-minute In-class exams @ 100 points each = 200 pts (45 %)
- Final exam (2 hr cumulative) = 150 pts (33 %)

Class assignment scores and point distributions will be updated on the ICON web site after each exam. Since this is a graduate level course, the average course grade will be near the B+/A- level (~3.5 GPA).

<table>
<thead>
<tr>
<th>Approx. dates</th>
<th>General lecture topics (MWF lectures)</th>
<th>West Text Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 - 2</td>
<td>General preparative synthesis &amp; crystal growth methods</td>
<td>Chp. 4 and handouts</td>
</tr>
<tr>
<td>Week 2 - 4</td>
<td>Atomic packing in solids and crystal structure types</td>
<td>1, 2 [F, 9/10 - PS1]</td>
</tr>
<tr>
<td>Week 4 - 5</td>
<td>Bonding descriptions, energetics, and defects</td>
<td>2, 3</td>
</tr>
<tr>
<td>Week 5 - 7</td>
<td>X-ray diffraction: theory and practice</td>
<td>5 [W, 10/6 - PS2]</td>
</tr>
</tbody>
</table>

**Friday, October 8**th **(end of week 7)**  
**First Exam (in class)**

| Week 8 - 9 | More XRD, solid solutions, powder structure solutions | 5, parts of 1 & 2 |
| Week 9 - 10 | MO to band structure approach to solids | 3, handouts [W, 10/27 - PS3] |
| Week 10 - 11 | Electrical and optical properties and semiconductors | 8, parts of 10 |
| Week 11 - 12 | Magnetic properties of solids: local and extended | 9 |
| Week 12 | Superconductivity: properties and structures | 8 |

**Wednesday, November 17**th **(mid-week 13)**  
**Second Exam (in class)**

| Week 14 | Low dimensional solids: polymers/chains | 8, supplements |
| Week 14 - 15 | Other special materials topics: TBD | 8, suppl. [F, 12/10 - PS5] |

**Cumulative Final Exam: Dec. 13 – 17. TBA after Registrar determines final exam schedule.**

**Note on Problem Set Assignments:** You may engage in general discussions about the homework problems with your classmates, but your work and answers must be a product of your independent reasoning and words. These are individual assessments of your problem solving abilities and not group assignments. Some of our text’s book problems have posted abbreviated online solutions to some assigned or recommended problems, but these are not sufficient for full credit answers.
ATTENDANCE AND CLASSROOM EXPECTATIONS. Students are responsible for attending class and for knowing an instructor’s attendance policies, which vary by course and content area. All students are expected to attend class and to contribute to its learning environment in part by complying with University policies and directives regarding appropriate classroom behavior or other matters.

ABSENCES. Students are responsible for communicating with instructors as soon they know that an absence might occur or as soon as possible in the case of an illness. Delays in communication could result in a forfeit of what otherwise might be an excused absence.

ABSENCES: ILLNESS, UNAVOIDABLE CIRCUMSTANCES, AND UNIVERSITY SPONSORED ACTIVITIES. Students who are ill, in an unavoidable circumstance affecting academic work, or who miss class because of a University sponsored activity are allowed by UI policy to make up a missed exam. Documentation is required by the instructor except in the case of a brief illness. Students are responsible for communicating with instructors as soon as the absence is known (https://opsmanual.uiowa.edu/students/absences-class#8.1).

ABSENCES: HOLY DAYS. Reasonable accommodations are allowed for students whose religious holy days coincide with their classroom assignments, tests, and attendance if the student notifies the instructor in writing of any such religious Holy Day conflicts within the first days of the semester and no later than the third week. (See the University Operations Manual: https://opsmanual.uiowa.edu/students/absences-class#8.2).

ABSENCES: MILITARY SERVICE OBLIGATIONS. Students absent from class due to U.S. veteran or U.S. military service obligations (including military service-related medical appointments, military orders, and National Guard Service obligations) must be excused without penalty. Instructors must make reasonable accommodations to allow students to make-up exams or other work. Students must communicate with their instructors about the expected possibility of missing class as soon as possible. (For more information, see https://opsmanual.uiowa.edu/iv-8-absences-class%C2%A0-0).

ACADEMIC MISCONDUCT. Plagiarism and the process for addressing academic misconduct of graduate students are defined in Section IV, Article F “Plagiarism by Graduate Students” of the UI Graduate College Manual of Rules and Regulations. Please contact the CLAS Associate Dean for Graduate Education for any necessary assistance in navigating the process mandated by the Graduate College.

ACADEMIC ACCOMMODATIONS. UI is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as a mental health, attention, learning, vision, and a physical or health-related condition) through the Student Disability Services (SDS) office. The student is responsible for discussing specific accommodations with the instructor. Note that accommodations are not granted retroactively but from the time of the student’s request to the instructor onward; additionally, accommodations must be requested at least two weeks in advance of the related assignment or exam (https://sds.studentlife.uiowa.edu/). Graduate students serving as Teaching Assistants, Research Assistants, or Fellows must contact Faculty and Staff Disability Services (https://hr.uiowa.edu/support/faculty-and-staff-disability-services) for assistance with accommodations.

CLASS RECORDINGS: PRIVACY AND SHARING. Course lectures and discussions are sometimes recorded or live-streamed. These are only available to students registered for the course and the intellectual property of the faculty member. These materials may not be shared or reproduced without the explicit written consent of the instructors. Students may not share these recordings with those who are not enrolled in the course; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and could be a violation of the Federal Education Rights and Privacy Act (FERPA); also see https://dos.uiowa.edu/policies/code-of-student-life/.

COMMUNICATION: UI EMAIL. Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community (Operations Manual, III.15.2). Emails should be respectful and brief, with complex matters
addressed during the instructor’s drop-in hours, for example. Faculty are not expected to answer email after business hours or during the weekends.

FREE SPEECH AND EXPRESSION. The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. Visit Free Speech at Iowa for more information on the University’s policies on free speech and academic freedom: https://freespeech.uiowa.edu/.

COMPLAINTS ABOUT ACADEMIC MATTERS. Students with a complaint about a grade or a related academic matter should first visit with the instructor and then with the course supervisor (if applicable), and finally with the director of the school, department, or program offering the course. If a graduate student has not been able to resolve the issue through the director of the school, department, or program, they should contact the associate dean for graduate education in the College of Liberal Arts and Sciences.

FINAL EXAMINATION POLICIES. The final exam schedule is published during the fifth week of the fall and spring semesters or on the first day of summer classes; students are responsible for knowing the date, time, and place of their final exams. Students should not make travel plans until knowing this information. A student with exams scheduled on the same day and time or who have more than two final exams on the same day should visit this page for how to resolve these problems by the given deadline (https://registrar.uiowa.edu/makeup-final-examination-policies). No exams are allowed the week before finals, but with some exceptions made for labs, language courses, and off-cycle courses (https://registrar.uiowa.edu/final-examination-scheduling-policies).

HOME OF THE COURSE. The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College. See https://grad.uiowa.edu/academics/deadlines.

MENTAL HEALTH. Students are encouraged to seek help as a preventive measure or if feeling stressed or overwhelmed. Students should talk to their instructors for guidance with specific class-related concerns and are encouraged to contact University Counseling Service (UCS) at 319-335-7294 during regular business hours to schedule an appointment. UCS offers group and individual therapy as well as counseling for couples about relationships while making referrals to other resources (https://counseling.uiowa.edu/). Student Health can also address related concerns (https://studenthealth.uiowa.edu/). These visits are free to students. After hours, students are encouraged to call the Johnson County Community Crisis Line at (319) 351-0140 or dial 911 in an emergency.

NONDISCRIMINATION IN THE CLASSROOM. The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals based on race, class, gender, sexual orientation, national origin, and other identity categories indicated by the University’s Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity at https://diversity.uiowa.edu/division/office-equal-opportunity-and-diversity-eod.

SEXUAL HARASSMENT. Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff; all members of the UI community are expected to conduct themselves in a manner that maintains an environment free from sexual harassment and sexual misconduct. Those experiencing Incidents of sexual harassment are strongly encouraged to report incidents and to seek help (https://osmrc.uiowa.edu/).
Cochranes molecular model kits (similar to those used for models shared in our class)


**General description (Z184772-1KT- Available to ship on August 20, 2021, $56)**

Use this introductory structural chemistry set to build and study models of: sulphur, sodium chloride, diamond, graphite, metals, hydrocarbons, acids and bases, detergents, nylon, water and ice, amorphous structures. Suitable for a student, teacher, researcher or a small group sharing. Includes instructions/activity booklet.

**ATOMS:**
- Scale: 3 cm = 0.1 nanometer (1 A), Orbit
- 1-prong: Hydrogen, white (91), Oxygen, red (5), Chlorine, green (4)
- 2-prong linear: Hydrogen, white (25)
- 2-prong 100°: Sulfur, yellow (9)
- 2-prong 110°: Oxygen, red (10)
- 3-prong 120°: Carbon, black (25), Nitrogen, blue (2)
- 4-prong tetrahedral: Carbon, black (50), Nitrogen, blue (4), Oxygen, red (20), Sulfur, yellow (2)
- 6-prong octahedral: Halogen, green (15), Metal, silver (15)
- 12-prong: Metal, silver (13), Orbit rigid mixed 10cm straws (1)

**BONDS:**
- Extra-thick, light grey, 3 cm (150)
- Rigid white, 5 cm (30)
- Very flexible white, 5 cm (4)

An extensive model system offering 15 atomic bonding configurations in 12 colors of plastic atoms. The carbon atom is represented in nine configurations: linear, trigonal (in five angle variations), tetrahedral, octahedral, trigonal-bipyramidal. Models come in two sizes: Orbit and Minit. Spare atom centers and bonding tubes are available for all model kits.